DIFFERENCE IN DBD DEVELOPMENT IN AIR AT NANOSECOND AND MICROSECOND VOLTAGE RISE TIME

Khomich V.Yu., Moshkunov S.I., Shershunova E.A.
Institute for Electrophysics and Electric Power Russian Academy of Sciences, St.-Petersburg, Russia, 191186, Dvortsovaya nab., 18
E-mail:eshershunova@gmail.com

Analysis of the discharge current waveform, *E/N* and ionization rate *(α-η)* showed that different modes of dielectric barrier discharge (DBD) were realized in 1-mm air gap at nanosecond (ns) and microsecond (us) voltage fall and rise time at the gap.

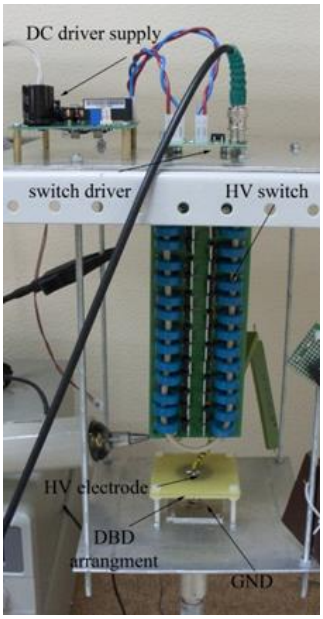

Figure 1. Solid-state DBD-power supply.

Solid-state DBD-power supply, providing us-pulses with ns-fall time (4-35 ns) and us-rise (12 us) time, with amplitude up to 20 kV and frequency up to 3 kHz, was developed (fig. 1). The "mixed" DBD mode was realized in plane-parallel 1-mm air gap. It is seen from fig. 2 that a single discharge current of ns-duration with amplitude of tens of amperes is formed at fast voltage drop. The breakdown voltage, calculated considering the gap geometry and barrier capacitance (30 pF) was ~ 12.8 kV, *E/N* ~ 480 Td, and ionization rate *(α-η)* estimated in Bolsig+ ~ 1450 1/cm^2 ($5.4\cdot10^{-21}$ m^2, as shown in fig.3). Due to Meek-Loeb criteria and the data from [1], it can be concluded that at ns-fall (or rise) voltage time many streamers develop synchronously and the DBD is rather diffuse. The opposite situation takes place at us-voltage rise (fig.2). The gap breakdown occurred at 4.7 kV/cm, – the static air breakdown voltage [2]: many random discharges of ns-duration with amplitude of tens-thousand mA were clearly seen in the current trace (fig.2), so it looked like a classic filamentary DBD in air.

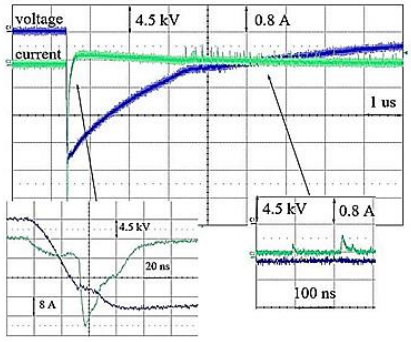

Figure 2. DBD current and voltage traces.

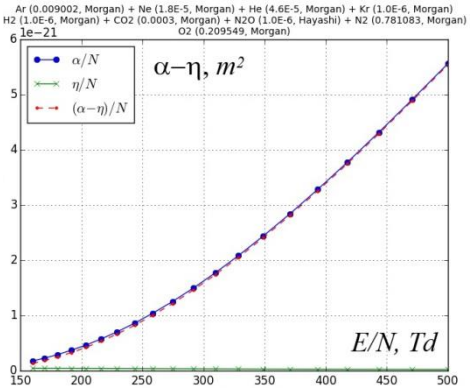

Figure 3. Ionization rate *(α-η)* via *E/N*. *(α* –impact*, η* – attachment*).*

This research was partially supported by RFBR; grant N. 16-08-01037.

REFERENCES

1. Malashin M.V., Moshkunov S.I., Khomich V.Y., Shershunova E.A. *Plasma Physics Reports.* **43** (2017) 170.
2. Raizer Y. P. *Gas discharge physics*. Nauka, Moscow, 1987.